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College of Computing, Engineering & Construction

Federal Communications Commission
Washington, D.C.

Regarding reply comments on the use of GOES weather data, the implications for spectrum sharing, Ligado's misunderstanding of the use of GOES weather data, and the NOAA interference study
WT Docket No. 19-116
Notice of Proposed Rule Making and Order,
Allocation of Service Rules for the 1675-1680 MHz Band

July 21, 2019

Introduction

The FCC requested comments in the subject docket regarding their proposal to allocate the spectrum between 1675 MHz and 1680 MHz for terrestrial fixed and mobile use. I submitted comments in this docket on June 21, 2019. Ligado filed an ex parte presentation in the docket on June 13, 2019 and comments on June 21, 2019. The presentation and comments filed by Ligado contain significant errors and demonstrate that they still do not understand how NOAA and the weather community use the GOES satellites. Further, their comments continue to advocate for a replacement communications solution that has already been shown to be unacceptable because it does not match the performance of the current GRB network and it will put lives in danger unnecessarily.

The errors within the Ligado presentation and comments are so numerous that I am submitting two sets of reply comments to address them. This set of reply comments is focused on Ligado's misunderstanding of the use of the GOES satellites by the weather community and also their misunderstanding of the usefulness of the NOAA interference study that is currently in process. A separate set of reply comments addresses how best to deliver NOAA GRB data (and HRIT data). Both sets of reply comments are intended to assist the FCC by providing input for them on the many requests for comments they included in the NPRM.

Ligado Continues to Misunderstand the Weather Community and their use of GOES weather data

As an educator I am proud of the patience I am able to infuse into my teaching of electrical engineering students and as a consultant I pride myself on carefully, thoroughly, and slowly explaining solutions to my telecommunication clients so that they understand the issue at hand. However, after 7 years of attempting to explain to Lightsquared, and their post-bankruptcy reinvention Ligado, how the weather community uses the GOES weather satellites, I am beginning to wonder if they might not be interested in understanding how important the environmental data is that these satellites carry. As a telecommunications engineer involved in public safety communications I am well aware of, what appears to me to be, the disregard that Ligado has shown the GPS community and now with their comments filed in this docket I think they may be showing their true colors toward the weather community. It seems to me that to Ligado anyone who is using L-Band spectrum is to be treated as an adversary to be defeated. This is clear to me when reading their June 21, 2019 comments where Ligado refers to GOES users as nothing more than "eavesdroppers" who have no legal right to use the spectrum. Wow, that sure reminds me of the same attitude they had toward anyone with a GPS receiver. In the weather community, these "eavesdroppers" include the likes of county emergency management offices, the Florida Department of Transportation (FDOT), Accu-weather, and many other clearly nefarious entities who according to Ligado are looking to eavesdrop on weather data they have no rights to. That Ligado may believe these comments they

have made to the FCC is simply sad, and I cannot explain how I and the weather community have failed so terribly over the past seven years as we have tried to educate them. Mea culpa Ligado.

The Truth and how it will help the FCC with this NPRM

Fortunately, the FCC has many competent engineers and lawyers who understand the importance of the weather data that is coming down from GOES at L-Band and are willing to have a reasonable discussion about how best to have everyone get along, and perhaps allow a lucky auction-winning 5G provider the opportunity to use 5 MHz of spectrum (or maybe a little less than 5 MHz). Part of the challenge in understanding how the weather community uses this spectrum is in recognizing that NOAA built the GOES satellites with three distinct L-Band satellite communication services that are in some important ways, very different from each other. The most significant difference, and one that even the FCC got wrong in their NPRM (as I pointed out in my June 21, 2019 comments), is that not all three satellite communication services handle NOAA weather data products.

The GRB and HRIT data products are created by NOAA and include original content that they develop from analyzing sensor data aboard GOES and from editing data from other sources, as well as national weather service inputs for emergency management. However, the third satellite communication service, DCS, transmits weather data that is owned by the users who create it and transmit it to the GOES satellites. In some cases these users are federal agencies like the USGS and the US Corp of Engineers, but in many other instances, the DCS users are non-federal agencies, like, for instance, the FDOT mentioned above, who monitors the data from almost 100 weather stations they paid for and installed, and maintain on bridges. The FDOT works with public safety partners in real time to determine, in advance of a storm, when it is too dangerous to allow the public to drive over those bridges. All of these Federal AND NON-FEDERAL users have official agreements with NOAA to share their weather data with NOAA and the public (weather community), in exchange for access to the GOES DCS satellite communication service. The GOES DCS service is not sending NOAA data down at L-Band, it is sending federal and non-federal user data.

For many of these Federal and non-federal DCS users, their own operation of an L-Band receiver earth station is the primary means of receiving the data from their own weather stations. A DCS L-Band earth station, known as a DRGS (Direct-Readout Ground Station), is for some users the only reliable solution. Entities such as the FDOT know through experience that the internet will be disrupted during severe weather events when the data from bridges is needed most. Therefore, they must have access to the GOES DCS data via satellite. The use of GOES is sanctioned by NOAA with the full knowledge that ANY of these entities, federal or non-federal, may install a DCS earth station. NOAA keeps track of federal and non-federal DCS users in the same database, keeps them all informed of any status updates of the DCS system and regularly invites federal and non-federal DCS users to their DCS meetings where the operation of these L-band DRGSs is always a prominent topic. To suggest that non-federal DCS users are nothing more than eavesdroppers is a ridiculous statement. In fact, because the DCS system is unique in that it carries user data and not NOAA data, and because NOAA treats federal and non-federal DCS users identically, and because DCS users who operate L-band DRGS equipment do so with the full knowledge of the options available and chose to operate DRGS equipment, it seems to me that the FCC, at a minimum should provide interference protection to all sanctioned DCS users who have sites that operate L-band DRGS equipment for receiving their own GOES DCS data.

Returning to the GRB and HRIT satellite communication services onboard GOES, as mentioned above, these two data products are NOAA data products - sourced by NOAA and intended to be delivered via satellite receiver to federal and non-federal users. The NOAA GRB and HRIT programs regularly interfaces with federal and non-federal users at the annual NOAA satellite conference. In addition, all federal and non-federal GRB users are encouraged to register on the NOAA GRB website. The HRIT satellite communications service was specifically designed in part to be delivered to emergency managers at the state and county level. The HRIT datastream includes the previous generation Emergency Managers Weather Information Network (EMWIN) data. Here again, to suggest that these public safety entities are "eavesdroppers" when they are the recipients NOAA built HRIT for, is outrageous and seems to me to be almost a futile effort to convince the FCC that, in particular, the public safety community is somehow not worthy of that privilege. I was present at the National Public Safety Telecommunications Council meeting in Las Vegas on March 25, 2016 when

then Ligado Vice President Geoff Stearn made a pitch to the council in part about the new Ligado services that support the public safety community. It is ironic that Ligado would want to do business with entities they now claim are "eavesdroppers" who have "no legal status" to receive the emergency management data in the HRIT L-band datastream that is intended for them.

The HRIT signal does include the data from each of the almost 30,000 DCS user platforms. The DCS user data is received directly by many of the federal and non-federal users who create it but DCS data is also received by NOAA and they reformat it and pack it into a single datastream before combining it with emergency management weather information and other weather products to create the HRIT datastream. The performance of the HRIT data communications service on the GOES satellite has improved over the past few years but many DCS users consider the latency in creating and delivering the HRIT data stream too long and are also concerned about the reduced availability of the HRIT service compared to that of the directly delivered DCS service. Never the less, if the FCC moves forward with sharing the spectrum without protecting all sanctioned DCS users or without resolving the resulting co-channel interference, or without permitting future DCS earth station deployments, then it is likely that some DCS users will consider migrating to HRIT because it will not be co-channel with the non-federal terrestrial users and will therefore be less susceptible to interference.

The NOAA Interference Study and Why it Matters

Ligado has claimed in their comments that the in-depth study that NOAA has undertaken to investigate the potential for interference and how to address it may not be relevant to the NPRM. Their assessment of a lack of usefulness of the study is predicated on the flawed assumption that their proposed content delivery network will replace all three satellite communication services onboard GOES. As they have been informed numerous times over the past few years, and I did again in my comments in June in this docket and also in my second set of reply comments filed today, their proposed solution will not be able to match the performance of the GOES GRB service. In addition, Ligado seems to have forgotten about federal users who will operate DCS receiver sites in a co-channel configuration in the NPRM proposal. This proposed co-channel configuration more than any other issue needs the results of the NOAA interference study to assess how to protect the DCS sites. The detailed on-air testing and analysis that is being completed in the NOAA study will be far more accurate and informative than the simulation and theoretical analysis done in the original Alion study. Remember, sharing L-Band geostationary downlink spectrum with terrestrial mobile users has never been done before. I would hope the FCC would want to get it right and not risk making a spectrum sharing mistake again similar to the one that happened when attempting to share adjacent public safety communications spectrum at 800 MHz with mobile non-federal terrestrial users 25 years ago (a spectrum sharing disaster that is still being resolved[1]).

What is the Solution?

Without the NOAA study it is impossible to fully assess the size of the protection zones that will be needed around approved GOES receiver sites (DCS, GRB, or HRIT). However, there are two additional changes that the FCC should consider making to the NPRM that will minimize interference and reduce the challenges that the FCC, NTIA, NOAA, GOES weather data users, and the new non-federal terrestrial users will face going forward. In addition, one of these two changes may actually increase the auction revenue and operating revenue associated with the use of the spectrum. This more significant change is specifically to restrict the shared spectrum for uplink use only. By restricting the spectrum for uplink use, only low power handsets will use the spectrum. This will mean the protection zones around GOES receiver sites will be much smaller, increasing the spectrum economic viability in the associated area. The NOAA study will hopefully help us accurately determine the size of the protection zones - a piece of information that is critical for a successful auction. Limiting operations in the spectrum to uplink services will also permit the use of dynamic geo-fencing in handsets, essentially locking out use of the spectrum in a protection zone by geo-location of the handset. This will allow new approved GOES receiver sites to be added in the future with minimal impact to fixed downlink infrastructure that has been built. The second change for the FCC to consider making is to reduce the 5 MHz of spectrum

[1] http://www.800ta.org/content/reporting/QPR_03.31.19.pdf

to 4.7 MHz, excluding the upper 300 kHz that overlaps with GOES DCS. By removing co-channel spectrum sharing the probability of interference will be significantly reduced. The NOAA study will hopefully tell us by how much. Given the spectrum building blocks supported by the 3GPP LTE protocol the majority of the 4.7 MHz could still be utilized for contemporary LTE service.

In summary, the FCC should in my opinion include the following changes in the NPRM to help ensure spectrum sharing is a success:

- Wait for the NOAA interference study to be completed before releasing any rule-making to ensure DCS, GRB, and HRIT users are protected from interference as much as possible.
- Provide interference protection to sanctioned federal AND NON-FEDERAL DCS users who operate L-Band earth stations.
- Permit only uplink operation by non-federal terrestrial users of the spectrum to minimize interference to DCS, GRB, and HRIT, to maximize spectrum geographic usage (and auction value), and to provide a means to support future earth station installations.
- Remove the upper 300 kHz from the 1675-1680 MHz band to protect all DCS L-Band earth stations from co-channel interference.
- Consider deploying a NOAA-approved and managed, commercial satellite-based content delivery system for GRB and HRIT as discussed in the second set of reply comments I filed today.

Hopefully the FCC will find these suggestions useful as well as the others presented in my original comments filed in this docket on June 21, 2019. Should you have any further questions regarding these comments please do not hesitate to contact me.

Regards,

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